

THURSDAY, AUGUST 26, 1886

## THE PHYSIOLOGY OF PLANTS

*Lectures on the Physiology of Plants.* By S. H. Vines, M.A., D.Sc., F.R.S. (Cambridge University Press, 1886.)

IT has already been pointed out in the columns of NATURE that our botanical schools in England are at present leading in great measure a parasitic existence on those of Germany in respect of the text-books which are in common use: translations of the works of Prantl, Sachs, and De Bary are in the hands of most of our students, while the number of manuals from foreign sources will shortly be increased by the publication of others which are in active preparation. However greatly we may admire the works of the above authors, still it is with no small satisfaction that we turn from them to the review of a book which we may well regard as the first-fruits of a renaissance in this country of the physiological branch of the science of botany; and the more so as the production of original text-books may be taken as one important indication of activity in the pursuit of the subject to which they relate. But while receiving this work of Dr. Vines with a hearty welcome, it is to be regretted that, as noticed in the preface, a considerable interval of time has unavoidably elapsed between the printing of the first sheets and the completion of the book: thus one great advantage of original production as opposed to translation, viz. that of being more nearly up to date, is in some measure lost in the present case, and it is to be hoped that the book will, as it well deserves, quickly run on to a second edition in which this defect may be remedied.

Those who have had the advantage of hearing Dr. Vines in the lecture-room would expect from him a clear style, and a skilful arrangement of the matter; and these are two of the most prominent characteristics of the work before us. Its scope is not that of a manual for mere beginners; it is rather constructed to meet the requirements of advanced students, and accordingly the author is freed from the *impedimenta* of external morphology and anatomy, a sufficient knowledge of which he presumes to have been acquired from other sources. But notwithstanding this presumption, the introductory lectures open in a manner easily followed by the uninitiated, and the whole could be read with advantage by any one who has become acquainted with the mere rudiments of vegetable anatomy.

The first three lectures are devoted to the structure and properties of the vegetable cell, including the osmotic and optical characters of its parts; this is preparatory to the study of the absorption of water, of the substances in solution in it, and of gases, which occupies the two following lectures, this subject being followed in fitting sequence by a discussion of the movements of water in plants, and transpiration. Lecture VIII. is devoted to the constituents of the food of plants, together with the more salient points as regards the functions of the several elements, and the sources from which they are obtained; in this, as in other parts of the book, a short historical

sketch is given of the development of knowledge and opinion regarding each several function. Then follows the subject of "metabolism" in its widest sense, a broad distinction being drawn between constructive metabolism, or the building up of the organised structures of plants, and destructive metabolism, or the conversion of more complex substances into others of simpler composition. It is in the treatment of the constructive metabolism that the most striking novelty will be found by English readers, in the introduction of a view regarding the formation of non-nitrogenous organic substance, which, though propounded some years ago in Germany, has now we believe, appeared for the first time in an English text-book. While allowing that starch is the first *visible* product of the constructive processes, the question is asked whether the starch which appears in the chlorophyll corpuscles of a green plant under the influence of sunlight is *directly* connected with the decomposition of carbon dioxide which goes on in them? The answer is as follows (p. 145):—"... according to Schmitz and Strasburger and in harmony with the older statements of Pringsheim, the cell-wall is produced by the actual conversion of a layer of protoplasm, and we shall see hereafter that the same is asserted of the layers of the starch-grains found in seeds, tubers, &c. Translating this into chemical language we find it to mean that molecules of protoplasm may undergo dissociation in such a way as to give rise to molecules of carbohydrate among other products. The conclusion to be drawn is, that the starch which is formed in chlorophyll corpuscles under the influence of light is also the product of such a dissociation of protoplasm."... Both here, and more definitely on p. 158, this point is accepted as proved, and is repeatedly referred to in the treatment of constructive metabolism. But, it will be asked, is it at all admissible thus to "translate" microscopical observations into chemical language? When it is remembered that we do not yet know the constitution of the molecule of protoplasm, that the protoplasm of a living cell is confessedly a most complex mixture, and that the observations quoted demand powers approaching the limits of microscopic observation, it would appear that this "translation" is little more than a figure of speech; that the process is *probably* as Dr. Vines describes it many will be found to admit, but it cannot be allowed that the evidence adduced by him is even a near approach to demonstration. This is not the only case of accepting a probability as a proved fact; thus on p. 174 we read:—"Seedlings, it is well known, contain considerable quantities of amides, and the presence of these can only be accounted for by regarding them as having been derived from the reserve proteids of the seed. It is then in the form of amides that nitrogenous organic substance is supplied to the seedling."

English readers will have become familiar with the view of Pfeffer and Draper that it is the yellow rays of the spectrum which are most efficient in the process of assimilation; and it will be a new idea to many that the balance of experimental evidence is rather in favour of the view of Lommel and others, more recently supported by the observations of Engelmann, that those rays which are absorbed by chlorophyll, viz. the red and violet rays, are the chief source of the energy which becomes latent in the process of formation of organic substance in green plants.

It is impossible within the limits of a short notice to take up more than these two points, but they will be sufficient to indicate that the part of the book which treats of metabolism contains much that is new to English readers both in view and in observation. At its close (p. 326) the results acquired are summarised in tabular form, constructed so as to appeal to the eye as a balance sheet, which takes account of income and expenditure of matter and energy, first in green, and then in colourless plants; this brings out clearly the conclusion that there is a nett balance in favour of the plant in either case, of both matter and energy.

The next section of the book (Lectures XV.-XXI.) opens with a description of the fundamental phenomena of growth, which is a clear statement of facts for the most part already familiar. This leads to a discussion, extending over four lectures, of the accompanying phenomena of irritability of growing organs, which result in their varied directive curvatures; two further lectures are devoted to the irritability of mature organs, considered in the light of the observations of Gardiner and others on the continuity of protoplasm; and the book closes with three lectures on reproduction; these include first an account of the chief types of both sexual and vegetative reproduction, and conclude with a discussion of the theories of sexuality of Strasburger, Naegeli, and Weismann.

With regard to the use of terms, two points demand notice: first, as to the words "dorsal" and "ventral," which have so often been the subject of discussion, especially because of the ambiguity arising from their different mode of application to leaves, and to dorsiventral shoots. But is it necessary to use the terms at all as applied to leaves? Will not the terms "anterior" and "posterior" convey the idea just as well, the terms "dorsal" and "ventral" being thus left free for application to dorsiventral shoots? Secondly, Dr. Vines has not accepted the term "zygote" proposed by Dr. Strasburger as generally applicable to the fertilised ovum: this term is of use in avoiding the terms "zygospore" and "oospore," which, especially the latter, are often understood in an ambiguous sense.

To say that Dr. Vines's book is a most valuable addition to our own botanical literature is but a narrow meed of praise: it is a work which will take its place as cosmopolitan; no more clear and concise discussion of the difficult chemistry of metabolism in the plant has appeared, while the part which treats of irritability is an able digest of the voluminous, one might almost say inflated, literature on this branch of the science. In estimating the value of the book as a whole, we must bear in mind the circumstances in which physiological botany is at present placed. There is no branch of biological science upon which it is more difficult to write; our position with regard to the phenomena of vegetable life is throughout based rather upon a calculation of probabilities than upon clearly established facts; it is for each individual teacher in the exercise of his duty to draw a line between the discussion of views, and the acceptance for teaching purposes of points still *sub judice* as though they were established truths. Dr. Vines has gone rather further in the acceptance of probabilities than some will be prepared to follow him, and it is perhaps to be regretted that this

should be the case in a book intended for the advanced rather than the elementary student. Placing this on one side, the book is one which must command admiration; a glance at the lists of references at the end of each lecture will give a clue to the extent of the literature which has been searched through; in erudition it stands alone among English books on the subject, and will compare favourably with any foreign competitors.

F. O. B.

#### A PLEA FOR THE RAIN-BAND

*A Plea for the Rain-Band, and the Rain-Band Vindicated.* By J. Rand Capron, F.R.A.S., and F.R.Met.S. (London: Edward Stanford, 1886.)

A NEAT little spectroscopic book, and furnished, as all such books should be, with a nice index, as well as not a few plates, which may be considered a second, or graphical, index of an instantaneous reference kind. But further it is both an honest, and a modest, production; for while it says nothing more on its title-page than what it fulfils, it has not cared to introduce there a compliment which it might have most legitimately claimed.

How often in literary history have not two words decided whether a book shall be bought and read, or not; these words being "second edition." But here they might have been exchanged for third, if not even fourth, edition, or "issue" [at all events, for the date January 1886.

Mr. Rand Capron is evidently of a very practical order, and writes for practical men; and as he writes only of what he fully understands, and has abundantly worked at with his own eyes and hands,—he has the faculty of pleasing and satisfying those whom he addresses. This is testified to most particularly by the successive reprints of his first pamphlet; within the short interval of five years; for though he was not the first and earliest rain-band writer, a public had to be created for the subject, and is evidently now rapidly increasing. This too notwithstanding that the feature wherein Mr. Capron's book is very strong, viz. numerical comparison of rain-band indications in the spectroscope, step by step with rain-gauge measures, or ozone papers, or hygrometrical readings of wet, and dry, bulb thermometers, forms by no means a smooth and easy-flowing kind of reading, as mere reading; however instructive it may be, and even necessary to have at hand to confront unreasoning objectors of an older school; endued often with imperfect senses, but all the more positive in their denunciations of a new departure in meteorology, on that very account.

If the poet is born, and is not to be manufactured by the tutors known in these days of cram as "coaches," so is it most assuredly with spectroscopic observers, when the subject to be observed is not the angular place of a sharp line, but the degree of intensity of a nebulous band of shade like the rain-band. Such intensity too to be determined, not by long and repeated observations with some grand photometrical apparatus mounted on a firm altazimuth stand, with tangent screw motions in every direction, but by a moment's look through a mere waistcoat pocket gem of an instrument held lightly between thumb and finger, and leading instantly to a judgment on the case, like a stroke of nothing less than pure genius.